**BIOS 338/538 Analysis and Visualization of Biological Data**
**Spring 2022 Course Syllabus**

Location: Keck 102 (or via zoom when required by university policy)
Time: Tuesdays and Thursdays 2:30-3:45 pm

Instructor: Dr. Lydia Beaudrot, Assistant Professor of Biosciences
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Office: ABL 272
Office hours: Mondays 3:00 – 4:00 pm

TA: Chia Hsieh, PhD student in Ecology & Evolutionary Biology
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Office hours: 3:45 – 5:00 pm on Thursdays or by appointment

*Course Description and General Information*

This course addresses how to analyze, visualize and draw conclusions from biological data. It introduces basic concepts in statistics interwoven with training in data analysis using the R computing environment. Students will learn to identify underlying data structures and wrangle data. Students will also learn to effectively convey results using statistical graphics. Topics include basic R programming, data exploration, statistical modeling, parameter estimation and interpretation, and model comparison. This class particularly focuses on biological data.

There will be a series of problem sets, which will each be posted on the course website a week before they are due. Problem sets must be submitted following the instructions posted with them. You are welcome to work with other students or use any outside resources when completing problem sets, but each student must submit their own written responses unless otherwise explicitly indicated in the problem set.

Students enrolled at the graduate level will produce a final project report detailing a specific biological research question, statistical methods and results and will present their final project to the class at the end of the semester.

*Course Material*

There is no textbook for the course. All required readings and supplementary materials will be posted on the course website. All code and data files will also be posted on the course canvas site. Code and data files will typically be made available before class meetings; slides will be posted afterwards.

*Assessment*

BIOS 338
Problem sets 60%

Midterm 20%
Final 20%

BIOS 538
Problem sets 60%
Midterm 20%
Final project presentation 10%
Final project report 10%

*Grading Scale*

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|---|---|---|---|
| A 93-100 | B 83-86 | C 73-76 | F <60 |
| A- 90-92 | B- 80-82 | C- 70-72 | |
| B+ 87-89 | C+ 77-79 | D 60-69 | |

**Course Policies**

*Late assignment policy*

Late assignments lose 10% per day. If problems arise that interfere with your ability to do the work in this class, please let me know as soon as possible.

*Religious-Academic Conflicts*

Students who expect to miss classes because of their religious observance will be provided with a reasonable alternative opportunity to make-up missed academic work, however it is your responsibility to provide me with reasonable notice of the dates on which you will be absent. Absence from classes for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence.

*Students with Disabilities*

If you think you may need an accommodation for a disability, please let me know at the beginning of the term. Next, you should contact Disability Resource Center (DRC). Once your eligibility for an accommodation has been determined, you will be issued an accommodations letter and we can arrange for your accommodation. Any information you provide is private and confidential and will be treated as such. If you already have an accommodations letter from the DRC, please present this form to me at the beginning of the term, but no later than at least two weeks prior to the need for the accommodation so that there is enough time for the appropriate arrangements to be made.

*Students Representing the University in an Official Capacity Off-Campus*

If you will be absent and may miss assignments because you are representing Rice University, please bring me an individualized class excuse form explaining the obligation(s). Please provide

the notice before the end of the fourth week of the term so that we can make alternative arrangements for you to complete the work.

*Academic Misconduct*

Rice University community functions best when its members treat one another with honesty, fairness, respect, and trust. The university promotes the assumption of personal responsibility and integrity, and prohibits all forms of academic dishonesty and misconduct. All cases of academic misconduct will be referred to the Office Student Judicial Programs Being found responsible for academic misconduct will result in a grade sanction, in addition to any sanction from the university. For more information, including examples of behaviors that are considered academic misconduct and potential sanctions, please see the Code of Student Conduct https://sjp.rice.edu/code-of-student-conduct#StandardOfConduct.

*COVID-19 Policy*

Every student in the classroom is expected to properly wear a mask or face covering [RICE CRISIS MANAGEMENT POLICIES] and to abide by Rice's physical distancing policy to maintain at least six feet of distance from other persons whenever possible. The instructor reserves the right to instruct students to leave the classroom if they are engaging in behavior that places faculty and/or students' health at risk. If students do not comply, the instructor may cancel the class meeting and refer the student to Student Judicial Programs and the Dean of Undergraduates or the Dean of Graduate and Postdoctoral Studies.

*Student Sexual Misconduct Policy*

Our school is committed to fostering a safe, productive learning environment. Title IX and our school policy prohibit discrimination on the basis of sex, which includes sexual misconduct — including harassment, domestic and dating violence, sexual assault, and stalking. We understand that sexual violence can undermine students' academic success and we encourage students who have experienced some form of sexual misconduct to talk to someone about their experience, so they can get the support they need. As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. I also have a mandatory reporting responsibility related to my role as a faculty member, which means that I am required to share information regarding sexual misconduct or information about a crime that may have occurred on Rice's campus with the University. Support and academic advocacy is available for you through the Office of Sexual Violence Prevention and Title IX Support (Resource Navigators) (713-348-3311) from 9 am – 5 pm on Monday – Friday. The Rice Counseling Center (713-348-3311) and Rice University Police Department (713-348-6000) are available 24 hrs/day. The Student Wellbeing Office (713-348-3311) and Student Judicial Programs (713-348-4786) are available 9 am – 5 pm on Monday – Friday.

*Student Mental Health and Wellbeing*

Rice University is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are

available 24/7. For help, contact the Rice Counseling Center (713-348-3311) or the Student Wellbeing Office (713-348-3311). Reports suggest that about 1 in 5 college students suffers from anxiety, depression, bipolar disorder or other mental health issues. Students with psychiatric disabilities are entitled to reasonable academic accommodations as provided by the American Disabilities Act (ADA) of 1990 and 2008 amendments. You do not need to have had your disability diagnosed before your arrival at Rice. To receive accommodations you must register with the Disability Support Services (DSS) Office in the Allen Center. A Rice student requesting accommodations must self-identify to the DSS office and provide recent documentation of their disability. This documentation is used to establish the Rice student as an individual with a disability, and provides rationale for reasonable accommodations. This process requires evaluation and documentation so do not wait until the last minute, speak with your healthcare professional or consult with the Student Wellbeing and Counseling Center (https://wellbeing.rice.edu). You will not need to disclose your specific disability with your instructor but documentation is required to secure accommodations.

*Diversity Equity and Inclusion Statement*

The Biosciences DEI mission statement can be found at https://biosciences.rice.edu/diversity-equity-and-inclusion. The instructors of this course are committed to its principles. This course may consider topics of historical and current discrimination, as well as unequal access to healthcare. Please feel free to discuss with the instructor any issues related to DEI that you feel are not being adequately addressed in this course.

*Gender Diversity Statement*

Everyone has the right to be addressed by the name and pronouns that correspond to their gender identity, including non-binary pronouns, for example: they/them/theirs, ze/zir/zirs, etc. Rosters do not list gender or pronouns so you may be asked to indicate the pronouns you use so that I don't make assumptions based on your name and/or appearance /self-presentation (you are not obligated to do so). If you use a chosen name, please let me know. Chosen names and pronouns are to be respected at all times in the classroom. Mistakes in addressing one another may happen, so I encourage an environment of openness to correction and learning. I will not, however, tolerate repeated comments which disrespect or antagonize students who have indicated pronouns or a chosen name. Chosen name and personal pronouns may evolve over time, so if at any point during the semester you would like to be addressed differently, please let me know.

*Land Acknowledgement*

The state of Texas, where Rice University is located, has been a meeting and trading location for Indigenous tribes including the Apache, Caddo, Comanche, Kiowa, and Wichita. Three federally recognized tribes and two state-recognized tribes currently reside in Texas. The land that Rice University occupies is the ancestral home of the Karankawa, Atakapa-Ishak, and Sana peoples. A painful history of settler colonialism, genocide, and forced migration and assimilation occurred here, and the descendants of these communities need to be recognized and included in the history of our community.

**Course Topics**

Below is a general description of the material to be covered. Note that topics and dates are subject to change. See course Canvas site for most up to date version.

| **Week 1** | | **Topic** |
|---|---|---|
| | 11-Jan | Introduction, overview and goals |
| | 13-Jan | R computing environment |
| **Week 2** | | |
| | 18-Jan | R Vocabulary 101 |
| | 20-Jan | R Grammar 101 |
| **Week 3** | | |
| | 25-Jan | Base graphics |
| | 27-Jan | Data exploration I |
| **Week 4** | | |
| | 1-Feb | Data exploration II |
| | 3-Feb | Hypothesis testing & significance |
| **Week 5** | | |
| | 8-Feb | T-tests and correlation |
| | 10-Feb | SPRING RECESS – No class |
| **Week 6** | | |
| | 15-Feb | Simple linear regression |
| | 17-Feb | Simple linear regression |
| **Week 7** | | |
| | 22-Feb | Multiple regression |
| | 24-Feb | Multiple regression |
| **Week 8** | | |
| | 1-Mar | Model comparison |
| | 3-Mar | Midterm |
| **Week 9** | | |
| | 8-Mar | Beyond Gaussian models I |
| | 10-Mar | Beyond Gaussian models II |
| **Week 10** | | |
| | 15-Mar | SPRING BREAK – No class |
| | 17-Mar | SPRING BREAK – No class |
| **Week 11** | | |
| | 22-Mar | Generalized linear models |
| | 24-Mar | Generalized linear mixed models |
| **Week 12** | | |
| | 29-Mar | Graphics principles |
| | 31-Mar | Beyond y ~ x |

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| **Week 13** | | |
| | 5-Apr | Intro to multivariate analysis |
| | 7-Apr | Machine learning basics |
| **Week 14** | | |
| | 12-Apr | Spatial statistics |
| | 14-Apr | Effective results & presentations |
| **Week 15** | | |
| | 19-Apr | Grad Student Presentations |
| | 21-Apr | Grad Student Presentations |